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BOOK OF ABSTRACTS **Open Access**

An analysis of intrinsic factors, performance, comfort and economy in relation to static and dynamic whole body kinematics in recreational and elite cyclists

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Abstract

Cycling has increased in popularity as a sport over the past decade. A properly configured bicycle is essential for optimal performance, comfort and injury prevention. Knee flexion angle has been studied extensively yet there is limited literature regarding the hip, shoulder and elbow flexion angle configuration adopted by cyclists and how alterations in bike fit influence these joint positions. In a review of the literature by Raymond et al (Raymond et al, 2005), they noted a need for further studies into the activity of the upper limb during cycling. Only two sources (Gregor and Conconi, 2000; Schmidt ,1994) have discussed the importance of the upper body in cycling and no scientific studies had been conducted into upper limb kinetics and kinematics and the effect that this has on the hip, knee and ankle angles.

In addition to the paucity of research with respect to upper body and hip kinematics, the use of both 2D and 3D kinematics in performance cycle fitment has increased dramatically. A study on the influence of saddle height on lower limb kinematics by Ferrer-Roca et al (2012) concluded that static methods did not coincide with dynamic methods. Peveler & Shew (2012) investigated the kinematic comparison of alterations to knee and ankle angles from resting measures to active pedalling during a graded exercise protocol, and found that ankle and knee angles changed significantly from a stationary position to a dynamic pedalling action. However these two studies provided widely differing outcomes with respect to the changes in joint angles measured from static to dynamic cycling. There have been no studies thus far comparing the static and dynamic hip, shoulder and elbow flexion angles, and the relationship between these angles and knee and ankle flexion angles.

We therefore aimed to determine proposed intrinsic factors that influence individual freely-chosen bicycle configuration by measuring flexion angles of the hip, knee, ankle, shoulder and elbow in a static position on the bicycle as well as by 3D kinematics measured during a dynamic cycling trial of 60min duration. 25 subjects (Age 33.4±8.2, mass 77.1±8.8, PPO 355.8±37.6) were enrolled for the study. Prior to the trials subject characteristics such as training history, training load, sit and reach test, Thomas test, knee extension angle test, fingertip to floor and modified Schober test were assessed. Subjects performed a VO2 max test followed by 3 steady state trials of 60min at a fixed workload equivalent to 60% of the power produced during a peak power output test. During the steady state trials dynamic 3D kinematics were captured using an 8 camera Vicon motion capture system (Oxford Metric, Vicon). In addition, measurements of oxygen consumption, cadence, power output, distance, heart rate, EMG activity (vastus lateralis, vastus medialis, biceps femoris, gluteus maximus, gastrocnemius and tibialis anterior muscles), RPE and pain levels were recorded.

Comparisons of the static and dynamic joint angles were compared over the 3 steady state trials to assess repeatability of the measurements & differences between static and dynamic values. Static measurements using a digital inclinometer were more reliable than measurements using a goniometer and dynamic measurement using Vicon motion capture (TEM: 3.30°,3.45° & 3.42° respectively). Static to dynamic measurements differed by an average of 9.7° over all 5 joints measured. Additional data were analysed to assess the relationship between individual cyclist characteristics, the static and dynamic joint angles adopted and how these affected the gross economy, muscle recruitment patterns, heart rate, cadence, RPE and pain scores. Bike configuration was not related to flexibility. Saddle height and saddle setback were moderately correlated with training history (r=0.39, r=0.35 respectively. Handlebar drop was largely correlated with training load (r=0.53). Subjects with greater relative power to weight (>4.7 W/kg) demonstrated significantly improved economy (p=0.049)..

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